Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/685
SWEDEN
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

Spatial Kinetics of Thermal Reactors

O. Norinder[1)]

In Sweden the theory of reactor spatial kinetics is studied and developments attempted to make the theory more clear and simplify its interpretation. Studies that elucidate the kinetic properties of the Marviken reactor are given particular attention. To be significant for this reactor the theory must be valid for macroscopically heterogeneous cores. The actual description of the reactor flux and other variables is mostly founded on the one-group time-dependent neutron diffusion equation. By expansion in the flux-mode system one obtains a graphical description of the time behaviour. The significant part of the transient is represented by the fundamental mode and the three higher modes. From the velocity characteristics of the transients one might group them as prompt jump -, fuel heat transport and delayed neutron -, external heat circuit -, xenon -, and depletion transients.

In kinetic investigations of reactors one generally uses several stability concepts. These must be defined. For a reactor the complete system always must be stable. Spatial stability conveniently is defined as stability without a control system or with a control system actuated by one real variable. Xenon spatial stability may be investigated using flux eigenfunctions. Computed tables of such functions are described.

A new theory of void distribution spatial stability is given. The theory makes possible numerical estimates of the stability conditions. In all cases calculated including unstable situations the flux part of the least stable eigenvector had only a small content of non-fundamental mode flux. In all unstable cases computed only this eigenvector had a positive real part eigenvalue.

1) AB Atomenergi, Stockholm

This fact indicates that in many investigations a space - time separated treatment of the flux is possible and that spatial instability in combination with fundamental mode stability is unlikely.

For calculation of transients it is mostly necessary to separate the space and time dependence. It is mostly possible to retain the significant characteristics of transients important to the reactor design when space - time - separated description is used. A short description is given of a code for calculating spatial transients. The possibilities of estimating spatial transient behaviour from static flux calculations are investigated. The demands for calculations or reactor spatial transients are discussed.